

BRODIOPTERA STRICKLANI N. SP.
(MEGASECOPTERA: BRODIOPTERIDAE),
A NEW FOSSIL INSECT FROM THE UPPER
MANNING CANYON SHALE FORMATION, UTAH
(LOWERMOST NAMURIAN B)

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The insect described in this report was collected from the uppermost units of the time-transgressive unit—the Manning Canyon Shale Formation, in central Utah. This formation of Late Mississippian to Early Pennsylvanian (Namurian A and B) age consists predominately of shales with interbedded limestones, orthoquartzites and some siltstones. A flora has been described from the upper portion of this formation at and near the collecting site for this insect. The flora from the upper Manning Canyon Shale, as presently defined, contains 43 genera and 103 species (Tidwell, 1967; Tidwell et al., 1974; Webster et al., 1984). Thus, it represents the most diversified flora of Carboniferous age presently known in western North America. Plant fossils from this formation consist of fern or fern-like foliage, lycopods, species with calamitean affinities, various seed types, cordaitean taxa and several forms related to microsporangiate structures. These plants indicate that the area was a swampy, moist lowland with perpetual summer-like conditions (Tidwell, 1975).

The Manning Canyon Shale is the oldest horizon reported to be insect-bearing in western North America (Durden, 1984). The age of the uppermost Manning Canyon Shale Formation remains uncertain. Many paleontologists and geologists consider the formation to be entirely Mississippian (Upper Namurian A: Bissell, 1959; Gordon and Duncan, 1970; and Webster et al., 1984). Others (Chamberlain and Clark, 1973; Sando, 1985) place the base of the formation in Upper Mississippian and the upper portion in the Lower Pennsylvanian (Namurian B and C). The majority of the fossil plants from the upper shales of this formation are encountered only in the Penn-

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sylvanian, whereas a small number of species are typically Mississippian. Therefore, we consider this upper flora, as well as the insect, to be lowermost Namurian B in age.

The insect specimen described in this paper is a compression fossil consisting of the body, four wings, cerci, legs, and antennae. It is assigned to *Brodioptera* of the paleopterous order Megasecoptera, which is related to the orders Diaphaneropteroidea and Paleodictyoptera. All of these Paleozoic orders had sucking beaks and probably fed by sucking the contents of fructifications and cones of lycopods, cordaites, and pteridosperms (Kukalová-Peck, 1983, 1985).

The oldest North American pterygote insect known so far is *Metropator pusillus* Handlirsch collected near "Altamount Colliery" in the Anthracite coal region of Pennsylvania (Carpenter, 1965). It is of historical note that there were two Altamount Collieries both near Frackville, Pennsylvania. Coal mined at the Altamount Colliery #1 was in the Tumbling Run Member of the Pottsville Formation which is Morrowan (Late Namurian) in age and coal mined at the Altamount Colliery #2 was in The Sharp Mountain Member of this same formation. The latter member is of Atokan (partly Westphalian B and partly Westphalian C) age. Since the coals for the Altamount Colliery are not older than the Tumbling Run Member, then the oldest this insect can be is Namurian B.

A rich Namurian entomofauna has been described from Europe, including Poland, Czechoslovakia, Belgium, and numerous specimens from the Ruhr Valley of West Germany. Further, two very well preserved and almost complete wings of Protodonata were reported from Namurian strata of Argentina in South America by Riek and Kukalova-Peck (1984).

The order Megasecoptera occurs from Upper Carboniferous to Upper Permian (Brues, Melander, and Carpenter, 1954). The numerous families composing this order have been separated mainly on differences in their venation. Most members of this order have been named on the basis of single wings. Because of its completeness, the specimen from the Manning Canyon Shale is a significant contribution.

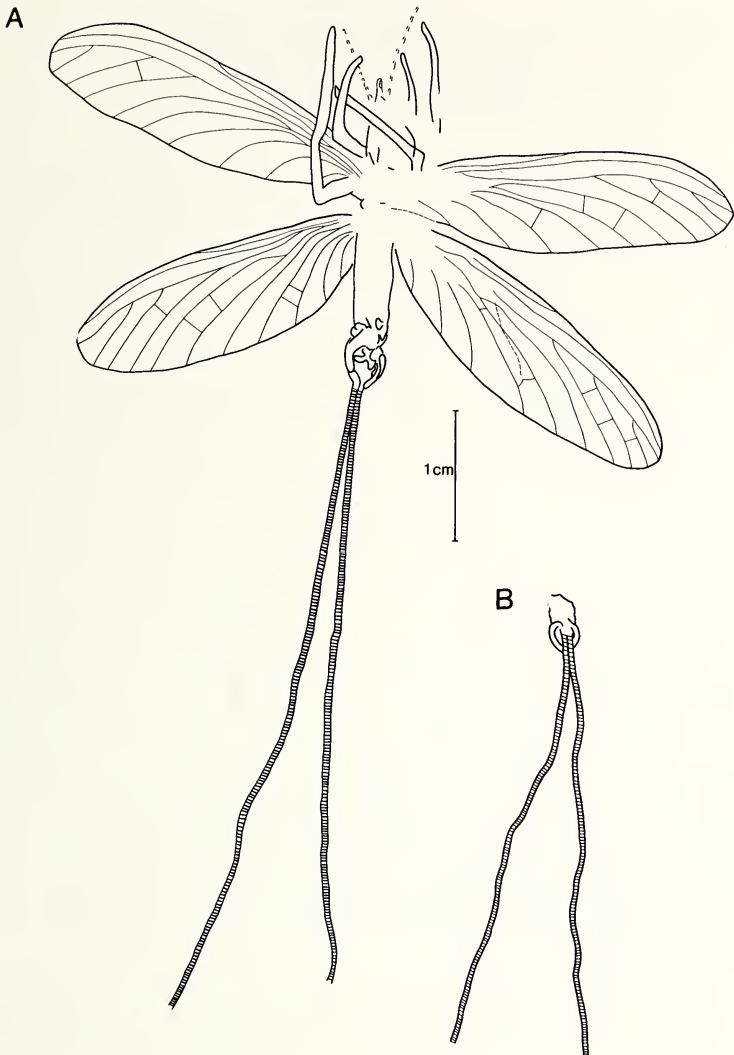


Fig. 1. A. Habitus of *Brodioptera stricklani* n. sp., holotype. B. Drawing of *Brodioptera stricklani* n. sp. BYU 3243, dorsal view of the male terminalia.

Megasecoptera
Brodiopteridae Carpenter, 1963
Brodioptera Copeland, 1957
***Brodioptera stricklani* n. sp.**

Figs. 1-2

HOLOTYPE. Male, UTAH, Utah Co., 1.5 miles East of highway 73 at point 4.3 miles west of Lehi (Sec. 9 T5S R1W, Utah County, Utah in Jordan Narrows Quadrangle; 40°23'30"N 111°57'30"W) in clay pits of the Manning Canyon Shale Formation of lowermost Pennsylvanian (lowermost Namurian B) age. Deposited in Brigham Young University paleontological collection as specimen #3160.

DESCRIPTION. Male, length from head to distal portion of genitalia 26 mm; expanse measured between apices of forewings of complete specimen 57 mm; head with vaguely preserved mouthparts; antennae filiform, incomplete right remnant 9 mm in length, left remnant 40 mm; legs poorly preserved, three on left side, two on right; length of each forewing 28 mm, width of each forewing measured at apex of Sc 8 mm; length of right hindwing 25 mm, not flat during preservation, length of left hindwing 28 mm, width of each hindwing 8 mm measured at apex of Sc. Wings as in Figs. 2a-d; Sc joining C near midlength of each wing; R₁ and R_s forking in basal quarter, R_s with four branches; MA and MP forking at 1/3 wing length, MA arching anteriorly near fork with MP to nearly contact R_s; CuA and CuP forking in basal 1/3; anal veins composed of three branches with A₃ seen only in right hind wing (Fig. 2d); crossveins few but straight and irregularly placed. Abdomen with faint indication of segmentation; genitalia 4.8 mm in length, composed of lateral claspers and medial gonapophyses, neither claspers nor gonapophyses with annulations; cerci long and filiform more than 54 mm in length.

PRESERVATION. The specimen of *B. stricklani* consists of a part and counterpart with characters better preserved on one rather than the other of the faces. The specimen is lying ventral side up. In this position, the basal portions of the wings are covered from view with the legs lying over parts of the specimen. Details of the head as well as the thorax including attachments of the legs and wings cannot be observed. The specimen is a compression fossil with concavities and convexities of the wings not apparent. Many of the structures of the specimen are indicated by hematitic material; however, the legs and

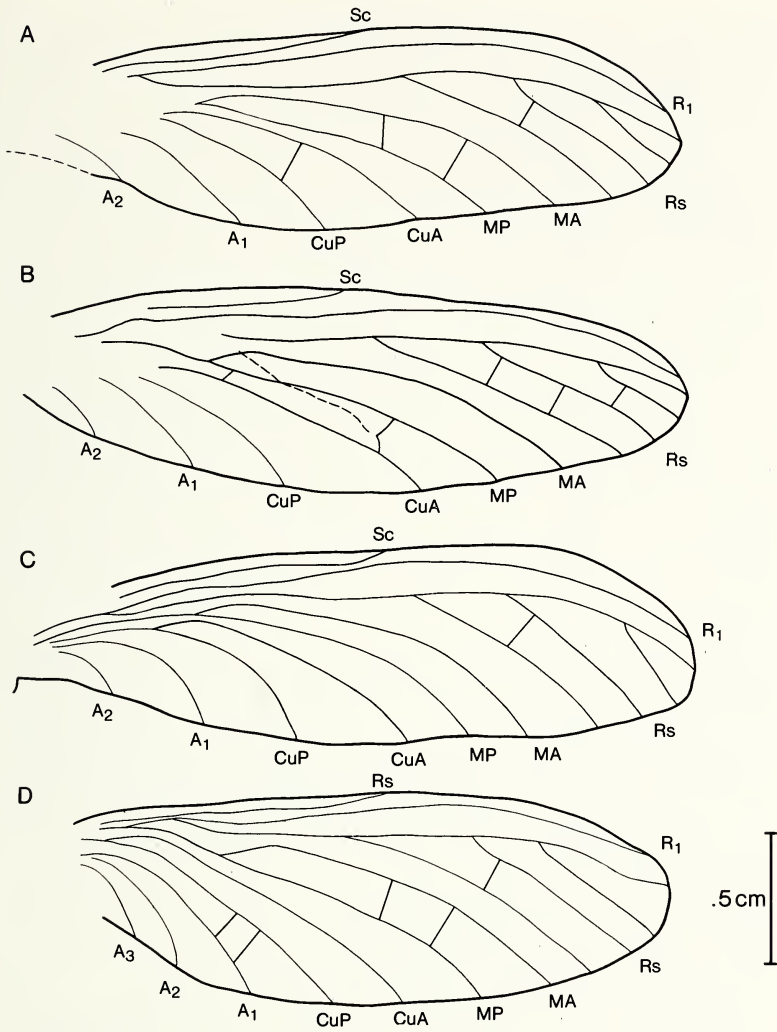


Fig. 2. A-D. Wings of *Brodioptera stricklani* n. sp., holotype; A. left forewing; B. right forewing. C. left hindwing; D. right hindwing.

some of the veins are raised areas or impressions depending on which face is viewed. Vague outlines of the head and sucking beak are indicated near the basal end of the antennae.

DIAGNOSIS. *Brodioptera stricklani* is closely related to *B. cumberlandensis* Copeland 1957. Comparison of the wing of *B. cumberlandensis* (Carpenter, 1963) reveals that it more closely resembles the forewing of *B. stricklani* than the hindwing. The two may be separated on the basis of details of forking patterns of the veins. The shorter subcosta of *B. stricklani* joins the costa at about the midpoint of the wing while that of *B. cumberlandensis* joins the costa well beyond the midpoint. The radial sector, media, and cubitus all fork more distally in *B. stricklani* than in *B. cumberlandensis*. Both the fore and hind wings of *B. stricklani* have a relatively broader anal region than does *B. cumberlandensis*. Further, the MA in *B. stricklani* does not curve forward as sharply as in *B. cumberlandensis*.

ETYMOLOGY. This species is named in honor of Mr. Dave Stricklan of Provo, Utah, who donated the holotype specimen for this study.

DISCUSSION. The well-spread wings of *B. stricklani* give supplementary support to the concept that Megasecoptera were unable to fold their wings over the dorsum of the abdomen and, therefore, that Carpenter (1963) was correct in placing *Brodioptera* in Megasecoptera. Further, the adequately preserved genitalia of this specimen closely resemble those of extant Ephemeroptera (Edmunds, et al., 1976) and should provide valuable information for future phylogenetic and evolutionary studies. It is interesting to note, as did Carpenter (1963), that such apparently apomorphic reduction in venation is present in an insect found so near the age (Namurian) in which the oldest winged insects have been discovered.

ADDITIONAL MATERIAL. A second specimen consisting of genitalia and cerci has been collected near the same locality as the holotype. The specimen is considerably smaller than the holotype but has a similar genitalic structure. This specimen consists of both the part and counterpart that reveal the dorsum of the specimen including the dorsal attachment of the cerci to the abdomen. This second specimen is tentatively assigned to *B. stricklani* and is deposited as figured specimen #3243 in BYU paleontological collection.

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SUMMARY

A fossil megasecopteran of the family Brodiopteridae, *Brodioptera stricklani* n. sp., is described. This is the first report of a nearly complete specimen of the family and is the first insect recorded from the transitional Mississippian-Pennsylvanian (Namurian A and B) Manning Canyon Shale Formation of Utah in western North America.

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